Clinical endodontic management during the COVID-19 Pandemic:

A literature review and clinical recommendations

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Abstract

The spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has resulted in millions of confirmed cases and hundreds of thousands of deaths. Despite all efforts to contain the spread of the disease, the number of infections and deaths continue to rise, particularly in some regions. Given its presence in the salivary secretions of affected patients, and the presence of many reported asymptomatic cases that have tested positive for COVID-19, dental professionals, including Endodontists, are at high risk of becoming infected if they do not take appropriate precautions. As of today, there are no predictable treatments or approved vaccines that can protect the public and health care professionals from the virus; however, there is speculation that a vaccine might be available sometime in 2021. Until then, general dentists and Endodontist will need to be able to treat emergency patients in order to relieve pressure on emergency clinics in hospitals or local community hubs. In addition, as the pandemic continues, strategies to manage patients will need to evolve from a palliative to a more permanent/definitive treatment approach. In this article, an update on the treatment considerations for dental care in general is provided, as well as a discussion on the available endodontic guidelines reported in the literature. Recommendations on clinical management of endodontic emergencies are proposed.

Introduction

Throughout the world, COVID-19 has had a major impact on healthcare professionals and their day-to-day work. The disease has created very challenging working conditions and a number of front-line staff have become infected and died because of the coronavirus (see: https://www.medscape.com/viewarticle/927976). Dentists are potentially exposed to the virus due to their close proximity to patients, specifically their mouths and respiratory tracts (Peng *et al*. 2020), thus coming into contact directly with the source of the disease. It has been reported that the coronavirus attaches to ACE 2 receptors found in the tongue, the floor of the mouth, saliva, and other oral structures (Xu *et al*. 2020, Khurshid *et al.* 2020), and thus the oral cavity can act as an initial site of entry to the body (Ahmed *et al*. 2020). In the present pandemic, resources must be utilized safely and efficiently. Ideally, dental procedures should be defined clearly and patients should be allocated to either general dental care practitioners and where possible and necessary, to specialists with additional knowledge and training.

Governments and regional medical and dental authorities have published guidelines for dental treatments. Some have taken radical measures to shutdown dental clinics, whilst others have allowed emergency and urgent care treatments, with some allowing elective procedures to be continued under strict protocols (Mallineni *et al*. 2020). The guidelines and treatment considerations that dentists must follow will remain region-specific, will rely primarily on the state of the pandemic in each individual country, and cannot be universally standardized. It was reported that during the outbreak of COVID-19 in China, the need for emergency dental treatments decreased by only 30% (Guo *et al*. 2020). Therefore, emergency dental treatments remain necessary and should be performed in dental practice to decrease the burden on the local hospitals and relieve the pain and suffering endured by those affected. The aim of this paper is to provide up-to-date information on the treatment considerations for dental care in general, discuss the available endodontic guidelines reported in the literature, and to propose new clinical recommendations on the management of endodontic emergencies.

Current recommendations

A) Provision of dental care

Several criteria have been proposed for the management of dental care during the COVID-19 pandemic (Abramovitz *et al*. 2020, Alharbi *et al*. 2020, Ather *et al*. 2020, Peng *et al*. 2020). All recommend having a tele-screening appointment, through a telephone or video call, to undertake a formal risk assessment and to reduce the chances of cross-infection. In addition to dental-related questions, it is recommended that patients should also be asked:

- whether they have a fever or flu-like symptoms, respiratory problems, change in taste or smell (Chen *et al*. 2020, Giacomelli *et al*. 2020.)
- whether they have been in contact with individuals who had these symptoms, or with a confirmed COVID-19 positive patient.

If the patient responds “NO” to these questions, and active dental treatment was deemed necessary, the same questions should be asked to the patients when they enter the dental clinic. This triage screening can be carried out by members of the dental team wearing the appropriate personal protection equipment (PPE) including, face mask, face shield, and protective gowns. Dental treatments should be carried out only when the patient is assumed to be free of infection or recovered from COVID-19 (U/U), i.e. when there are no symptoms present for 30 days or after a negative laboratory test result.

If the patients are suspected or are confirmed as having COVID-19 through triage assessment, they should be only treated in a well-equipped dedicated dental care facility or in a hospital-based setup prepared to receive COVID-19 patients. Such a dedicated facility should contain isolated well-ventilated rooms or rooms with negative air pressure, so that procedures can be carried out under strict isolation and infection control protocols. Healthcare providers should be aware of their local dedicated dental care facilities that can provide dental/endodontic services for symptomatic or suspected COVID patients. However, this is subject to the level of pain or related symptoms experienced by the patient. If COVID-19 patients have stable respiratory disease, minimally invasive procedure can be performed with the patient in the semi-supine or upright position to prevent respiratory depression (Abramovitz *et al*. 2020). A pulse oximeter should be used to monitor the oxygen saturation in the blood, and provision of oxygen supplementation should also be considered (Kaplowitz, 1997). Treatment provided should be definitive not palliative, if applicable, in these patients because of the potential of health deterioration (Abramovitz *et al*. 2020).

B) Treatment protocols

If clinical treatment is deemed necessary, specific clinical protocols should be put in place. These considerations are listed in Table 1. The patient should be asked to attend the dental facility alone without company, unless the patient is a minor, or has a physical or mental disability that requires a supporting carer (Ebben *et al*. 2020). Patients should be seated at least approx. 2 meters away from the unaffected care-unit in a well-ventilated room and asked to wear masks until being seated on the dental chair (GenBank 2020). . Before beginning the oral examination, The CDC has initially indicated that patients should be instructed to gargle with 0.23% povidone-iodine or 0.5% to 1 % hydrogen peroxide (H_2O_2) for at least 15 seconds prior to initiating dental exam/treatment due to their non-specific viricidal activity against coronavirus (Kampf *et al.* 2020). Most recently, the recommendation has been removed from the CDC guidelines as there was no evidence of any efficacy in decreasing the viral load with this protocol.

Table 1: Treatment Protocol

1) **Walk-in patient**

- Companions should not be allowed
- Unnecessary items should not be brought
- Alcohol based hand disinfectant for patient
- Temperature checking upon arrival
- On-arrival screening/triage & travel history

- Assessment of emergency or urgent care needs.

2) Dental facility considerations for COVID positive patients

- Short waiting time
- Waiting area allows social distancing (6-feet/2 meters) apart
- Wearing masks in the waiting room
- Restricted movement to and from the dental room
- Tissue paper dispenser & foot operated waster bin
- Use of HEPA filters in dental care facilities with commercial split and centralized/window ACs
- Isolated well-ventilated room/negative pressure room for COVID positive patients
- Disinfection of frequently touched surfaces with NaOCl and ethanol
- Disinfection with 1000 mg/L chlorine containing disinfectant for floor mopping and sprays
- 15 min interval after patient leaves before disinfection protocol is commenced
- "Critical" heat sensitive instruments should de disinfected with 2% glutaraldehyde
- Waste marked and disposed in accordance to the CDC guidelines
- Self-assessment of health by health-care workers regularly

3) Treatment considerations

- Consider every patient a COVID carrier
- Fit-tested respirators
- The use of Personal protective equipment (PPE) (Gloves, masks, gowns, and face shields)
- Extra-oral imaging techniques
- Only dentists and assistant present during treatment
- Avoided nitrous oxide sedation
- Use of rubber dam
- Use of high-volume suction
- Minimally invasive procedures
- Semi-supine or upright patient chair position for COVID positive patients with stable respiratory disease
- Avoid aerosol generating procedures when possible
- Disposable single use instruments
- Four-handed dentistry

C) Endodontic intervention

Following the COVID-19 outbreak in Wuhan, China, Yu *et al*. (2020) characterized the type of dental emergencies and reported that patients with symptomatic irreversible pulpitis were the most common form of emergency. They indicated that pulpotomy was very effective in controlling the patients' symptoms, however, they did not provide any statistical data on the level of effectiveness of such treatment, or the management of patients with acute apical abscess or other endodontic conditions requiring root canal debridement. Ather *et al*. (2020) categorized the type of endodontic interventions during the pandemic into primary and secondary treatment protocols. For cases with symptomatic irreversible pulpitis or symptomatic apical periodontitis, pain medication through a combination of ibuprofen and acetaminophen or dexamethasone were advised by the authors. If that medication proves ineffective, full pulpotomy was advised as the secondary protocol. Antibiotics were recommended for primary management only in cases of an acute apical abscess (AAA) in addition to incision for drainage for fluctuant intra-oral swellings. Vital pulp therapy, such as pulp capping and pulpotomy was indicated as a secondary management protocols in symptomatic tooth fracture cases. These guidelines did not clearly address case selection and management when symptoms persist. Additionally, no criteria were provided for teeth where treatment had been initiated previously, and no caution related to the use of ibuprofen was mentioned. Abramovitz *et al*. (2020) addressed some of the limitations in the Ather *et al*. (2020) protocol with a focus on providing clinical interventions, instead of pharmacological treatment, and reducing the number of treatment visits needed. They suggested pulpotomy for symptomatic irreversible pulpitis, cracked teeth with vital pulps, and symptomatic complicated crown fractures. In cases of symptomatic apical periodontitis, acute apical abscess, primary or secondary endodontic lesion, and pupal necrosis, mechanical debridement and canal dressing was proposed. In retreatment cases where canal filling material cannot be retrieved, occlusal reduction and pharmacological management were recommended.

The British Endodontic Society (Bhanderi & Tompson 2020) proposed a palliative approach for the treatment of endodontic disease using verbal advice, and detailed analgesic and antibiotic regimens for both adult and pediatric patients. They also recommended that only cases with AAA and severe swelling that may compromise the airway would be referred to an emergency department for clinical intervention. Interestingly, no clinical

intervention was indicated as a first or second protocols of treatment, unlike the above-mentioned studies. This guideline was found to be the most conservative. The International Federation of Endodontic Associations (IFEA) and the Indian Endodontic Society (IES) also suggested through a joint statement that partial or complete pulpotomy would be the recommended protocol to manage cases with irreversible pulpitis (Krithikadatta *et al*. 2020). They also proposed a pharmacological approach to manage severe dental pain. However, no other diagnostic modality was addressed in these guidelines. The aforementioned articles and summary of their findings is listed in Table 2. Other recommendations have also been proposed by the Scottish Dental Clinical Effectiveness Program regarding management of acute dental pain during the pandemic (SDCEP 2020). Similarly, they lacked specificity regarding the appropriate treatment modalities for the various endodontic clinical scenarios.

Table 2: Papers with guidelines regarding endodontic intervention

Title	Type of Study	Outcome of the Paper	Reference
Characteristics of Endodontic Emergencies during Coronavirus Disease 2019 Outbreak in Wuhan	Clinical Research	• Discussed the type of dental and endodontic emergencies encountered in Wuhan during COVID-19 pandemic • Recommended vital pulp therapy to reduce the treatment time for endodontic emergencies • Highlights the importance of using rubber dams, personal protective equipment (PPE), and pre-treatment patient screening	(Yu *et al.* 2020)
Dental care during the coronavirus disease 2019 (COVID-19) outbreak: operatory considerations and clinical aspects.	Protocol	• Overview of the operatory considerations, general dental clinical aspects, endodontic considerations, and surgical aspects • Discussed the logistics and clinical steps to manage patients • How to control cross-contamination and use the appropriate PPE	(Abramovitz *et al.* 2020)

Coronavirus Disease 19 (COVID-19): Implications for Clinical Dental Care	Review Paper	• Reviewed symptoms, routes of transmission and epidemiology of the disease • Discussed prevention of nosocomial Infection • Discussed management of patients through Tele screening • Divided endodontic intervention into Primary (pharmacological management) and secondary (pulpotomy/vital pulp therapy) to manage clinical symptoms	(Ather *et al.* 2020)
British Endodontic Society Information and Advice on Triage and Management for Primary Dental Care and other healthcare providers during the COVID-19 Pandemic	Position statement	• Suggested verbal advice, and detailed analgesic and antibiotic regimens to manage endodontic pain	Bhanderi *et al*. 2020
Endodontic and dental practice during COVID-19 Pandemic	Position statement	• Recommended medications to manage severe dental pain • Recommended vital pulp therapy to reduce the treatment time	Krithikadatta *et al*. 2020

Recommendations for endodontic treatment

Extensive endodontic recommendations are presented herein based on previously published data, with several modifications and adjustments for the following reasons:

1- To stabilize the patient's dental condition long enough to avoid any rebound effects or tooth loss.
2- To protect dental and auxiliary staff from repeated visits by the same patients to manage endodontic pain until the pandemic is over.
3- To protect the patient from potential exposure to the virus during repeated visits.
4- To reduce the burden on hospital emergency clinics.

Endodontic treatment is a specialized modality that is profoundly affected by COVID-19. It represents the majority of emergencies in dental practice. It often requires multiple and longer treatment visits, and inevitably generates aerosols. This results in an increased and repeated exposure to the coronavirus for the dentists, their staff and patients. In a study conducted in China, out of all patients attending for emergency dental care during a 10 days period, 50% were endodontic emergencies, with 53% being symptomatic irreversible pulpitis (Yu *et al*. 2020). Endodontic therapy

is the most predictable approach through which the signs and symptoms of endodontic disease can be controlled, and a tooth can be saved. Despite the undesirable circumstances, Endodontists have a special responsibility to save teeth and relieve the patients' symptoms. The timeline related to the resumption of 'normal' dental activities is uncertain in different regions. Even if or when dental care facilities are fully operational, special care is potentially needed to minimize cross-infection until a predictable treatment or vaccine for COVID-19 becomes available. For these reasons, if clinical intervention is deemed necessary, it seems sensible to suggest that clinicians should consider definitive treatments to minimize the chance of patient presenting for further intervention, and thus reduce possible cross-contamination risks.

Endodontic treatments can be classified into three categories; 1) emergency procedures requiring immediate attention, 2) urgent care procedures requiring prompt attention, but not as immediate as a true endodontic emergency, and 3) elective procedures that can be scheduled at the patients'/providers' convenience. For suspected/confirmed COVID patients, only endodontic emergencies should be considered, and provided using either palliative (pain medication and/or antibiotics) or clinic intervention in a dedicated dental facility. For unsuspected/recovered patients, clinicians may consider addressing both emergencies and urgent care scenarios in a typical dental facility to avoid further deterioration of the patients' dental condition. Clinicians might consider deferring elective endodontic treatments for unsuspected or recovered COVID-19 patients or address them on a case-by-case basis. A recommendation on classification and management of various clinical scenarios related to Endodontics are presented in Fig. 1 and Table 3.

Table 3: Description of the different types of endodontic treatments performed in the dental office.

Endodontic emergencies	Endodontic urgent care	Elective endodontic treatment
• Symptomatic irreversible pulpitis • Symptomatic apical periodontitis • Acute apical abscess • Avulsion • Intrusion • Luxation • Complicated crown fractures • Complicated crown-root fracture	• Chronic apical abscess • Concussion/subluxation • RCT following avulsion/luxation injuries • Vertical root fracture (VRF) • Internal/external root resorption • Uncomplicated crown fractures	• Normal pulp • Asymptomatic irreversible pulpitis/Necrotic pulp/previously initiated/previously treated w' a) Normal apical tissue b) Asymptomatic apical periodontitis • Endodontic surgery • Tooth discoloration/ Internal bleaching

Diagnosis

Endodontic diagnosis using pulp sensibility tests can be carried out normally (Balevi, 2019). Extra-oral radiography, however, such as cone beam computed tomography (CBCT), can be given preference in COVID positive patients, since it can provide more specificity regarding disease detection, treatment planning and tooth anatomy (Cohenca & Shemesh 2015, Lemagner *et al.* 2015, AAE/AAOMR 2016, ESE 2019, Chogle *et al.* 2020) while minimizing intra-oral manipulation that may cause gagging or a cough reflex. If CBCT is not available, a panoramic radiograph can be used.

In cases where extra-oral radiographs are not available, or intra-oral radiographs are needed for further treatment/assessment, clinicians should consider limiting the number of radiographs as much as possible to only unsuspected or recovered COVID patients.

Armamentarium

Endodontists usually perform most endodontic procedures under high magnification using a surgical operating microscope, resulting in fewer procedural errors, and better clinical outcomes (Khalighinejad *et al.* 2017). The current CDC guidelines suggests that provider should wear goggles or face shields together with the N95 masks, when aerosols are generated. Endodontic microscopes, in their current status, are incompatible with the proposed PPE and the utilization of a face shield. Some modifications, however, can be implemented to ensure further protection to the operator from splatter and droplets produced while using the high-speed handpiece. Disposable plastic barrier can be attached to the scope binoculars to provide a physical barrier between the clinician and the patient. Another approach would be mounting a hard-plastic barrier directly on the surgical microscope with the barriers being disinfected after every procedure (Fig. 2). Most recently, Russell (2020) developed a high-speed vacuum line with a polycarbonate shield that can be mounted on the dental operating microscope to reduce unimpeded oropharyngeal aeriosol transmission.

Loupes can also be used if they have side coverage, and a face shield and an appropriate mask is also worn. Eye protection and face shield may also be added when using the surgical operating microscopes, if they do not hinder visibility. Clinicians, however, should be aware that

protective eyewear (e.g., safety glasses, trauma glasses) with gaps between glasses and the face likely do not protect eyes from all splashes and sprays (CDC).

The most important protocol to reduce aerosol spread into the operatory is the use of a rubber dam. It should comfortably cover the mouth and nose of the patient. It has been shown that the application of rubber dam alone reduces aerosol production up to 90% (Cochran *et al*. 1989). If there are technical difficulties associated with its application, a split dam technique can be used (Li *et al*. 2004). The tooth surface and the rubber dam sheet can be disinfected with sodium hypochlorite prior to starting treatment. An important device to reduce aerosol formation is the high vacuum suction. It removes air up to 2.83 m^3/min and reduces aerosols and contamination by 90% (Narayana *et al*. 2016). The high-efficiency particulate air (HEPA) filter is another device that removes 99.97% of the airborne particles measuring 0.3 μm (Howard 2003). However, it may become a contaminated source if the microbes are retained and proliferate back into the filtered air. Additionally, they are difficult to clean, expensive to replace and may not be effective against Corona viruses, due to its smaller particle size that ranges between 0.06 – 0.14μm (Chuaybamroong *et al*. 2010, Day *et al*. 2018, Zou *et al*. 2019)

Endodontic treatment

If endodontic intervention is needed to address the patients' symptoms, clinicians should consider a more definitive treatment, when applicable. Aerosol-production is only a concern at the beginning of most endodontic treatments, e.g. during caries/restoration removal, access preparation, and at the end of treatment during occlusal adjustments. All the other procedures related to canal instrumentation, irrigation, or even canal filling, and restoration placement, do not produce aerosols.

Treatments such as vital pulp therapy (pulp capping or pulpotomy) which are effective in reducing pain, can be accomplished in a short time, and have a high success rate (Li *et al.* 2015, Qudeimat *et al.* 2017, Taha & Khazali 2017, Taha & Abdelkhader 2018). Care, however, should be taken for proper case selection to minimize the possibilities of immediate clinical failure, exacerbation of symptoms, and the need for another treatment appointment. If root canal debridement is deemed necessary to control symptoms/disease (symptomatic apical periodontitis, acute/chronic apical abscess), the clinician should consider a single-visit root canal treatment. In an overview of systematic reviews, Moreira *et al*. (2017) reported no difference in the outcome of root canal treatment between single and multiple-visit treatments, with a trend of lower post-operative complications and higher efficiency in treatments completed in a single session. Single visit treatment is a safe, effective, and well-tolerated procedure even in

cases with acute apical abscess, if complete drainage is achieved from the canal, or via incision and drainage, and the canal(s) are dry at the time of filling (Southard & Rooney 1984).

Certain procedures, such as non-surgical retreatment, may require a longer treatment time. Performing a lengthy procedure can place the patient and the treating clinician at a lower-risk of cross-contamination compared to the potential need for two appointments. Complete debridement and placement of anti-bacterial intracanal medicament such as calcium hydroxide would be the alternative approach if the treatment cannot be completed in a single visit (Athanassiadis *et al*. 2007, Mohammadi & Dummer 2011, Shabbir *et al*. 2020). due to time or treatment-related reasons. Therefore, it is recommended that an experienced dental practitioner or Endodontist should carry out these procedures. Only in case of an acute apical abscess with severe swelling that may compromise the airway, should the patient be referred to an emergency clinic for clinical management as suggested by the British Endodontic Society (Bhanderi *&* Tompson 2020). Although endodontic surgery is most often an elective procedure, it might the only treatment approach to address a patients' symptoms. In such cases, clinicians might be at a greater risk of exposure to aerosols due to the absence of a rubber dam. If applicable and available, clinicians may consider requesting the patient to take a COVID-19 test prior to engaging in surgical intervention. They can also consider using surgical handpieces and ultrasonic units without the built-in coolant, and use instead external irrigation through a plastic syringe.

Preferred restorative approach

Since elective dental procedures might be postponed in certain locations, patients may not be able to see their general dentists in a timely manner to place a permanent intra-coronal or a full-coverage restoration. Attempts should be made, in coordination with the referring dentist, to restore the tooth with a direct permanent restoration such as composite or amalgam, to minimize tooth/restoration fracture, crack propagation, or coronal leakage (Madison & Wilcox 1989, Dammaschke *et al.* 2013). If temporary intra-coronal restorations are to be placed, calcium sulfate-based material should be avoided due to their low compressive strength, solubility, and expansion (Widerman *et al*. 1971). Occlusal reduction should also be considered to minimize post-operative pain (Nguyen *et al*. 2019) and the risk of tooth/restoration fracture.

Management of traumatic injuries

If a suspected or confirmed COVID patient arrives with a tooth avulsion/luxation injury, it is preferable not to do any intervention in a typical dental care facility and the patient should be referred to a specially equipped dental facility for management according to the International Association of Dental Traumatology (IADT) guidelines (Anderson *et al*. 2016, Diangelis *et al*. 2017). For avulsion, the tooth should be kept in a readily available storage media such as milk (Adnan *et al*. 2018). For unsuspected or recovered COVID patients, the IADT guidelines should be followed, and any clinical intervention should follow the proposed guidelines mentioned above.

Pharmacological management

Controlling the symptoms of patients through medication should be considered as the primary treatment approach for suspected or confirmed COVID patients. A case report suggested that the use of ibuprofen caused further deterioration of systematic symptoms in four COVID -19 positive patients (Day 2020). This resulted in statements from several health organizations, including the WHO, warning against the use of ibuprofen for suspected or confirmed COVID-19 patients (Edmunds 2020). In their last update, the WHO has retracted their warning regarding the use of ibuprofen due to insufficient evidence. Accordingly, clinicians may consider the use of ibuprofen alone or in combination with acetaminophen, or dexamethasone to control dental pain for COVID-19 positive patients, depending on the severity of pain. (Ather *et al*. 2020). Clinicians may follow their normal post-operative pain medication protocols and the guidelines for antibiotics prescription (Fouad *et al.* 2017, ESE 2018, Lockhart *et al*. 2019).

Conclusion

The guidelines from previous publications, as well as the recommendations proposed in this paper, are only suggestions offered to practitioners to help them in their daily operation and planning until the pandemic is over or under control. The ultimate decision on patient management and treatment should be made by the clinician to provide what is in the patients' best interest. Clinicians may consider these guidelines as long as they do not contradict those published by local authorities and/or governmental instructions within each state or country.

Conflict of interest

The authors deny any conflict of interest.

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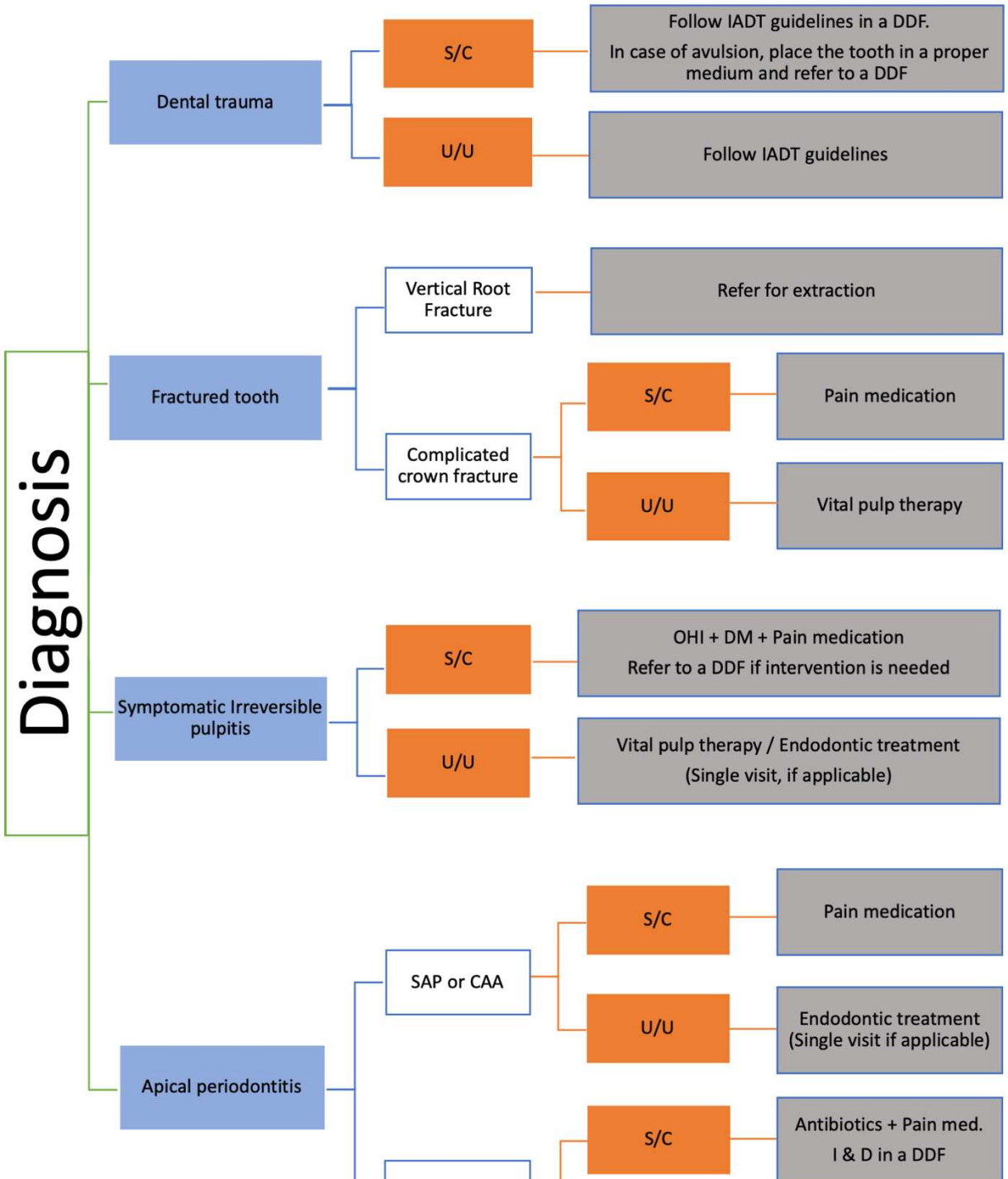
Diagnosis
Dental trauma
S/C
Follow IADT guidelines in a DDF.
In case of avulsion, place the tooth in a proper medium and refer to a DDF
U/U
Follow IADT guidelines
Fractured tooth
Vertical Root Fracture
Refer for extraction
Complicated crown fracture
S/C
Pain medication
U/U
Vital pulp therapy
Symptomatic Irreversible pulpitis
S/C
OHI + DM + Pain medication
Refer to a DDF if intervention is needed
U/U
Vital pulp therapy / Endodontic treatment
(Single visit, if applicable)
Apical periodontitis
SAP or CAA
S/C
Pain medication
U/U
Endodontic treatment
(Single visit if applicable)
S/C
Antibiotics + Pain med.
I & D in a DDF

Figure Legends

Fig 1: Recommendations for the management of endodontic emergencies and urgent care cases during the COVID-19 pandemic.

CAA: Chronic apical abscess

DDF: dedicated dental facility

DM: dietary modification

OHI: Oral hygiene instruction

SAA: Symptomatic apical periodontitis

S/C: suspected/ active COVID-19 patient

U/U: unsuspected, nonactive COVID-19 patient

Fig 2: Demonstration on how to protect the operator while using the surgical operating microscope using: a) a disposable plastic barrier, b) a plastic protective barrier (EndoUnderCover, EndoPower, TX - USA)